Egypt, J. Plast. Reconstr. Surg., Vol. 47, No. 1, January: 13-19, 2023

Comparative Study between Split Thickness Skin Graft and Split Thickness Dermal Graft in Coverage of Raw Areas

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ABSTRACT

Background: Loss of skin integrity is one of the most common problems in Plastic surgery. Split thickness skin graft is the gold standard in coverage of raw areas but it carries multiple complications like donor site morbidity. The dermal graft may add another autologous option for wound coverage with a concealed donor site scar.

Aim: The aim of our study is to assess the safety, limitations, and complications of split thickness dermal graft in coverage of raw areas and to compare it to the standard Split thickness skin graft.

Patients and Methods: The study was conducted on 38 patients with raw areas, who attended the outpatient clinics and Emergency Department of Plastic Surgery Department, Beni-Suef University Hospital between October 2019 to October 2021. The mean age was 50 years (range 5-55 years). Raw areas were divided and covered by both split thickness dermal graft (STDG) and split thickness skin graft (STSG). Comparison of donor and recipient site of dermal graft and the standard skin graft was documented using POSAS (Patient Observer Scar Assessment Scale).

Results: The Split Thickness skin graft take was complete in 37/38 cases. While Split Dermal Graft Take was complete in 33/38 patients. Most Dermal graft failure occurred in large raw areas. The scar of the dermal graft donor site was better than the standard skin graft donor site regarding pain, itching, color, and texture using POSAS.

Conclusion: Split thickness dermal graft had proved to be a valuable adjunct and wholly autologous option in achieving permanent raw areas coverage with decreased donor site morbidity, especially in small sized raw areas.

Key Words: *Graft – Dermal – Raw – Area.*

Disclosure: No Financial Support and Sponsorship: Nil.

Conflicts of Interest: There are no conflicts of interest.

INTRODUCTION

Raw areas through loss of skin integrity are one of the commonest problems facing the plastic surgeons. Coverage of such raw areas is very important to protect wounds from infection and fluid loss, also it is crucial to restore skin function and minimize morbidity. Skin grafting is considered one of the oldest and earliest surgical methods for raw areas coverage **[1,2]**.

However, STSG remains one of the most important options for definitive wound closure **[3]**, it still has many disadvantages like donor site morbidity, which is considered the main drawback. The procedure results in a second painful wound that may take more time for healing than the graft site itself **[4]**. Such wound also carries the risk of some complications like infection, hyper or hypo pigmentation, burning sensation, itching and even excessive scarring that may minimize the range of motion **[2]**. The split-thickness skin graft is a weak coverage that may ulcerate if exposed to mechanical forces, also it may adhere to the underlying structures **[5,6]** in addition to limited donor site availability in major burns **[7]**.

Many studies innovate many new techniques to cover skin raw areas, One of the most interesting techniques is the use of split thickness dermal graft (STDG) **[8]**. Early or late coverage of dermal grafts with a split-thickness skin graft has been described by Hynes in 1954 **[9]**. In 2002, Rubis explored STDG instead of The STSG in pig models **[10]**. In 2011, Andrew et al., use the dermal graft, as another autologous option in coverage of raw areas in acute burn wound coverage **[11]**.

In our procedure the split-thickness skin graft was elevated in a classic manner. Then dermal split thickness graft was harvested from donor site, then reposition of the split thickness skin graft to its original place. Dermis graft take at the recipient wound site occurs by its components of skin appendages. The procedure results in a nearly concealed scar at the donor site.

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PATIENTS AND METHODS

A- *Patients:*

Between October 2019 to October 2021 in Plastic and Reconstructive Surgery Department, Beni-Suef University, 38 patients with raw areas due to different causes like burn or trauma were managed. The study included 21 males and 17 females. Their age ranges from 10-55 years with mean age 28±13.2. The donor site of the both types of the grafts was the thigh. The recipient sites were the lower limb in 26 patients, the upper limb in 10 patients and 2 cases at the trunk (Fig. 1).

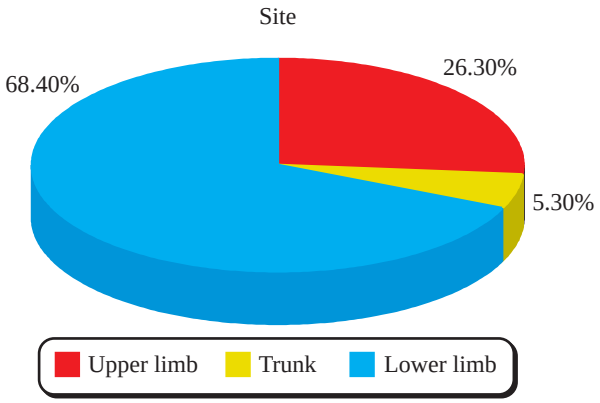

Fig. (1): Graph showing the distribution of the sites of the raw areas.

Inclusion criteria:

- Male and female patients from 10-55 years old.
- Raw areas that may result from trauma or deep partial thickness and third degree burn.
- Wound measuring more than 4cm x 4cm with clean, healthy granulating bed.
- Patients who accept to participate in the trial and be able to comply with the weekly visits and follow-up regime.

Exclusion criteria:

- Raw area of face.
- Patients with skin diseases (psoriasis, skin infections, xeroderma pigmentosa).
- Immunocompromised patients (malignancy, corticosteroid therapy & AIDS).
- Infected wounds.
- Presence of one or more medical conditions including renal, hepatic, hematologic, active autoimmune or immune diseases, uncontrolled diabetes mellitus (HBA1c >8 percent).

Patient counseling and consent:

The study was approved by the Faculty of Medicine, Beni-Suef University Research Ethics Committee. Written informed consent about the procedure and any complications including post-operative wound infection, graft loss or donor site problems was obtained.

B- *Preoperative assessment and preparations:*

Patients screened for inclusion in the trial, eligible patients subjected to the routine assessments including:

- History taking includes personal history, chronic illness and present history about the cause of raw area.
- Laboratory investigation including CBC, albumin level, INR, HBA1c.
- Proper analysis of the raw area like assessment of the site, dimensions, depth of the defect with exclusion of any vital structures that may be present in the floor of the defect like exposed vessels or nerves.
- All wounds were prepared by using the traditional wound dressings to achieve a healthy granulating bed.
- Wound swabs were taken to ensure no bacterial growth.

C- *Operative Technique:*

Anesthesia:

General or spinal anesthesia according to the age and the site of raw area.

Operative details:

Prior to grafting, the wound was cleaned using wound irrigation solution by the surgeon and debrided if necessary.

The raw area in the same patient was divided into two halves. One-half was covered by STSG and the other one by STDG. Marking of the raw area & the donor site of both STSG & STDG was done.

- STSGs (from one thigh) were harvested using the electric dermatome, where the thickness was set to 0.012 to 0.018 inches (Fig. 2-A). Meshed and unmeshed STSG was applied and tailored to the recipient site.
- STDGs (from another donor area rather than that of the STSGs) were harvested using the electric dermatome. First STSG was just elevated, where its thickness was set to be 0.010 to 0.012 inches. Then the blade was re-setted to 0.012 to 0.016 inches, and STDG was harvested from the same area (Fig. 2-B). More than one STDGs (Split Thickness Dermal Graft) could be elevated, but to avoid healing problems at the donor site, subcutaneous fat must not be exposed (Fig. 3-

A). After harvesting STDGs reapplying the STSG to its original site can be done (Fig. 3-B).

- Recipient site will be divided and marked into two halves. One half will be grafted by STSG and the other half by STDG.

Fig. (2-A): Harvesting of STSG by the electric dermatome.

- Dressing on donor and recipient sites by Vaseline gauze and dressing (most of the cases were at upper and lower limbs and so the dressing was in the form of Vaseline gauze, dressing and creep bandage).

Fig. (2-B): Harvesting of STDG.

Fig. (3-A): After harvesting of STDGs without appearance of subcutaneous fat.

Fig. (3-B): Reapplying the STSG to its original site after harvesting STDGs.

D- *Post-operative care:*

- First dressing on recipient site was at 5th day post-operative as soon as there was no discharge or bad odor from the dressing, then day after day until complete epithelialization is completed.
- First dressing on donor site was done 2 weeks post-operative.

E- *Postoperative observation index:*

- After discharge, patient were followed-up every week until complete healing of donor and recipient sites.
- Repair time (the complete epithelialization of the wound) was documented by photography of the wound and recorded.
- Follow-up of donor and recipient sites of both type of grafts was done until complete healing.
- Patient and Observer Scar Assessment Scale (POSAS), which analyses pliability, vascularity, pigmentation, and surface area of the wound, in addition to patient assessment of pain, itching and color of the wound was used to assess both donor and recipient sites. The score ranges from 1 (normal skin) to 10 (worst scar).

Statistical analysis:

Data were collected from patients in the form of a written questionnaire. Data were processed by the SPSS program. Mann Whitney test was used to test differences between patients in two groups. *p*-value <0.05 was considered significant.

RESULTS

STSG take was complete in 32/38 cases, partially taken in 5/38 & not taken in 1/38. STDG Take was complete in 24/38 patients, partially taken in 9/38 & not taken in 5/38. Most Dermal graft failure occurs in large raw areas. The partially taken grafts healed by secondary intention while rejected grafts had another session of split thickness skin graft.

Using The Patient and Observer Scar Assessment Scale (POSAS), patients documented decreased pain & itching in dermal graft donor site with better color of the dermal graft donor site.

The observer documented better pigmentation and texture of the donor site of the dermal graft.

Regarding the patient opinion about the recipient site of both grafts, the patient documented no significant difference except in the thickness as the dermal graft, which had a better thickness.

Observer opinion about the recipient site shows that there was a significant difference in texture, pliability & surface area between both grafts. The dermal graft was smoother and more pliable than Split thickness skin graft. The surface area of the dermal grafts does not shrink like split thickness skin graft.

Table (1): Demographic data of the studied patients.

Characteristics	STSG Group	STDG Group	*p*-value
Age:			
Mean ± SD	28.3±13.05		0.7
Range	10-55		
Gender:	Frequency	Percent	
Males	21	55.3%	
Females	17	44.7%	
Site:			
Lower limb	26	68.4%	
Upper limb	10	26.3%	
Trunk	2	5.3%	
Graft takes:			
Fully taken	32	24	0.9
Partially taken	5	9	0.6
Not taken	1	5	0.2

Table (2): Patient's scale of the graft donor site.

Donor site	STSG	STDG	*p*-value
Patient scale:			
Pain	8.9±1	1.6±0.7	0.003*
Itching	8.7±1.08	1.3±0.5	0.004*
Color	5.02±1.1	1.2±0.4	0.04*
Stiffness	2.9±0.9	1.5±0.5	0.6
Thickness	2.9±1.04	1.3±0.5	0.5
Irregularities	2.3±0.9	1.5±0.5	0.3
Overall	3.9±1.1	1.4±0.5	0.1

Table (3): Observer's scale regarding donor site.

Donor site	Total STG	Total SDG	*p*-value
Observer scale:			
Vascularity	2.8±0.9	1±0.2	0.1
Pigmentation	4.6±0.8	1.1±0.3	0.04*
Texture	2.2±1.03	1.5±0.5	0.01*
Thickness	1.9±0.9	1.4±0.5	0.8
Pliability	2.1±0.8	1.3±0.5	0.7
Surface area	1.07±0.2	1±0	0.9
Overall	3.13±0.9	1.2±0.4	0.05*

Table (4): Patient's scale regarding recipient site.

Recipient site	STSG	STDG	*p*-value
Patient scale:			
Pain	2.7±0.7	2.3±0.8	0.1
Itching	2.9±0.7	1.7±0.7	0.2
Color	3.5±1.4	3.2±1.3	0.2
Stiffness	3.3±0.8	2.5±0.9	0.2
Thickness	3.3±0.8	2.7±0.7	0.001*
Irregularities	3±0.9	2.8±0.8	0.2
Overall	3.6±1.1	2.9±1.1	0.1

Table (5): Observer's scale regarding recipient site.

Recipient site	STSG	STDG	*p*-value
Observer scale:			
Vascularity	3.1±0.8	2.4±1.5	0.8
Pigmentation	3.4±0.9	3.12±1.8	0.4
Texture	3.8±1	1.8±1.4	0.04*
Thickness	3.4±0.8	2.6±1.2	0.6
Pliability	3.8±0.8	1.7±1.2	0.05*
Surface area	3.3±1.2	1.9±0.7	0.05*
Overall	3.7±0.7	2.9±1.6	0.8

Clinical Cases

(A) (B)

(C) (D)

Fig. (4): N.B: The blue circle represents the site covered by STDG while the blue triangle represents the site covered by STSG. (A): Post burn raw area at the dorsum of the hand. (B): Immediately after coverage by STSG and STDG. (C): At the time of first dressing. (D): 2 weeks postoperative.

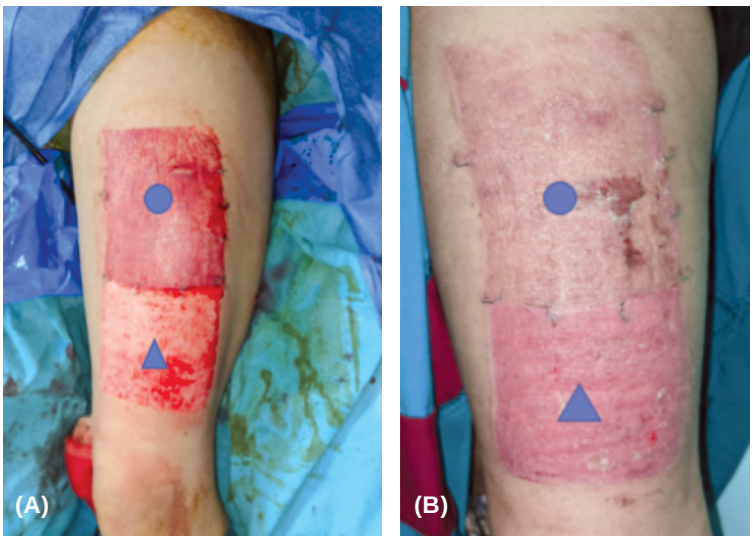

Fig. (5): (A): Donor site intraoperative, the blue circle represents the site of STDG while the blue triangle represents the site of STSG. (B): 3 Weeks postoperative.

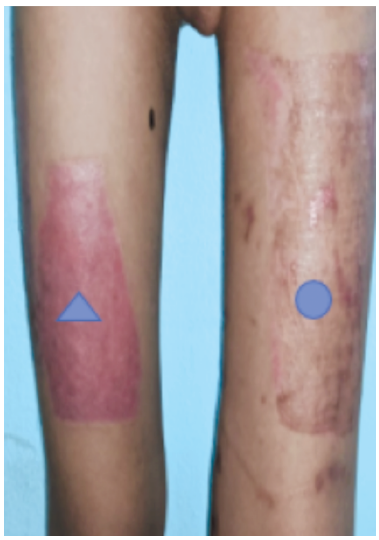

Fig. (6): Represents the donor sites of STSG and STDG after 1 month postoperative. The blue circle represents the site of STDG while the blue triangle represents the site of STSG.

DISCUSSION

Split-thickness skin grafts remains the cornerstones for definitive wound closure **[3]**. Multiple complications start to appear with more delay in the process of raw areas healing as infection and sepsis with increased mortality and morbidity. Postoperative sequelae like itching and pain at the donor site of STSG, in addition to the poor aesthetic outcomes that result from scarring of both the donor and recipient sites are annoying problems to the patients **[7]**.

The aim of our study is to assess the advantages and disadvantages of the split thickness dermal graft as a new autologous technique for coverage of raw areas post-trauma and burn.

Re-epithelization by dermis grafts depends on that the split thickness dermal graft has a remnant of skin appendages with their epithelial linings. The differentiation and migration of basal epithelial cells onto the surface of the graft results in recipient site healing **[13]**.

Our study was conducted on 38 patients complaining of raw areas post-trauma and post-burn. The raw areas were divided into two parts, one part covered by the standard STSG and the other part by STDG.

The Split Thickness skin graft take was complete in 32/38 cases, partially taken in 5/38 & rejected in 1/38. While Split Dermal Graft Take was complete in 24/38 patients, partially taken in 9/38 & rejected in 5/38. The partially taken grafts healed by secondary intention while rejected grafts have another session of split thickness skin graft. Most Dermal graft failure occurs in large raw areas.

The main cause of STSG failure was infection and sheering movement while the main cause of dermal graft failure was the large raw area in addition to infection & sheering movements. In a study done by Andrew on 16 cases of raw area post-burn, take of dermis graft occurred in 15/16 cases, but complete failure of one graft occurred due to insufficient burn excision **[10]**.

In our study, the graft was fixed in the same position as it was in the original donor site, so after harvesting of the graft the freshly cut surface was in direct contact to the wound bed. We considered that the epidermal cells migration from the skin appendages should be unidirectional. In a study done by Crouh, the papillary dermis of the dermal graft was facing upwards in most cases **[14]**. Interestingly the studies of Querings & Fratila were different in the way of application of dermal graft as the application of dermal graft was in 'reversed' position in their studies and they needed to cover such dermal graft by another STSG 2 weeks later **[15,16]**.

In the study held by Andrew, complete healing of the donor site of the STDG takes 7-35 days (mean 16.1 days), while the STSG donor site takes about 7-35 days (mean 16.7 days) for complete healing **[11]**. The study held by Kogan and Govrin-Yehudain on humans stated that good donor site healing occurred within 14 days **[17]**. The study of Rubis showed that epithelialization of donor site occurs from adnexal structures in the deep dermis in 1 week in all six pigs **[10]**. In our study healing of the STDG donor site occurred in 1 week (1.2+ 0.3), while healing of STSG donor site occurred in an average of 2 weeks (2.4+0.5).

In our study, the healing of the donor site of STDG occurred earlier than the donor site of standard STSG and other dermal graft studies. That is due to the difference in our technique from other studies, as in our study we elevated STSG first, then the STDG was harvested from the same area. After harvesting STDGs reapplying the STSG to its original site. This technique ensures rapid healing and concealed scar with the same color, thickness, texture, and pliability of the donor site to the surrounding area. This technique is beneficial as it decreases potential scarring and guarantees rapid healing.

In our study, we used Vaseline gauze to do dressing on donor and recipient sites due to its availability with applying bulky dressing and crepe bandage. Rubes et al., choose to dress donor areas by bacitracin ointment and xeroform gauze. An op-site dressing was placed over the surgical site to prevent wound soiling **[10]**, while Andrew uses skin substitute Suprathel as a temporary coverage to the dermis graft to facilitate epithelialization **[11]**.

In our study complete epithelialization of dermal graft in the recipient site occurred in an average of 3 weeks (3+1.2), our study has shown that epithelialization occurs uniformly from the graft itself. Reed demonstrated that dermal grafts re-epithelialization started by the migration of epithelial cells from skin appendages in the edges of the dermal graft, not from the edges of the wound **[13]**. Tanabe stated that the rates of epithelialization in small plantar dermal grafts harvested to cover palmer and digital wounds happens in 14-21 days **[18]**.

The study done by Kogan and Govrin-Yehudain included only small dermal grafts and reported an average epithelialization rate of only 13 days **[17]**. Moreover, regarding our cases with graft failure and delayed healing, the main cause was large raw areas in addition to infection. Andrew reported delayed graft healing in cases with major burns with significant time loss in the Burn Intensive Care Unit and more than 50% of these patients had severe comorbidity that might hinder healing process **[11]**.

In our study, there was no significant difference between the take of STSG and STDG in small raw areas while there was a significant difference in graft take of STSG and STDG in large raw areas, but we found a significant difference between STSG & STDG recipient sites in texture, pliability, and surface area. The recipient site of STDG was better in texture and pliability and had less tendency to contract in comparison to the STSG recipient site.

Andrew in his study compared donor site healing and epithelialization of STSG and STDG by two experienced burn surgeons, while in our study we used the POSAS (Patient Observer Scar Assessment Scale) which documented the opinions of both: The patient and surgeon which showed that: there was a significant difference between STSG & STDG donor sites documented both by the observer and patients. Regarding the pain, itching, and scar of the donor sites, it was remarkable that the donor site of STDG was better than the STSG donor site in color and texture with a nearly concealed scar. It was noticeable that pain and itching were less in the donor site of STDG than STSG.

Conclusion:

Split thickness dermal graft appeared to be a valuable adjunct and wholly autologous option in achieving permanent small raw areas coverage, with decreased donor site morbidity.

REFERENCES

1- Subrahamanyam M.: Honey dressings accelerate split thickness skin graft donor site healing. Indian J. Surg., 77 (Suppl 2): S261-S263, 2015.

2- Lauerman M.H., Scalea T.M., Eglseder W.A., Pensy R., Stein D.M. and Henry S.: Efficacy of Wound Coverage Techniques in Extremity Necrotizing Soft Tissue Infections. Am. Surg., Nov. 01; 84 (11): 1790-1795, 2018.

3- Rotatori R.M., Starr B., Peake M., et al.: Prevalence and Risk Factors for Hypertrophic Scarring of Split Thickness Autograft Donor Sites in a Pediatric Burn Population. Burns., Aug., 45 (5): 1066-1074, 2019.

4- Brown J.E. and Holloway S.L.: An evidence-based review of split-thickness skin graft donor site dressings. Int. Wound J., Dec. 15 (6): 1000-9, 2018.

5- Lee Y.J., Park M.C., Park D.H., Hahn H.M., Kim S.M. and Lee I.J.: Effectiveness of Acellular Dermal Matrix on Autologous Split-Thickness Skin Graft in Treatment of Deep Tissue Defect: Esthetic Subjective and Objective Evaluation. Aesthetic Plast Surg., May 19, 2017.

6- Oh S.J., Kim S.G., Cho J.K. and Sung C.M.: Palmar crease release and secondary full-thickness skin grafts for contractures in primary full-thickness skin grafts during growth spurts in pediatric palmar hand burns. J. Burn Care Res., Sep-Oct. 35 (5): e312-6, 2014.

7- Otene C.I., Olaitan P.B., Ogbonnaya I.S. and Nnabuko R.E.: Donor site morbidity following harvest of split thickness skin graft in south eastern Nigeria. J. West African Coll. Surg., 86-96, 1 (2), 2011.

8- Nuutila K., Singh M., Kruse C. and Eriksson E.: Wound healing from dermal grafts containing CD34+ cells are comparable to wound healing with split thickness skin micrografts. Plast. Reconstr. Surg., 140 (2): 306-314, 2017.

9- Hynes W.: The skin-dermis graft as an alternative to the direct or tubed flap. Br. J. Plast. Surg.,7: 97-107, 1954.

10- Rubis B.A., Danikas D., Neumeister M., Williams W.G., Suchy H. and Milner S.M.: The use of split-thickness dermal grafts to resurface full thickness skin defects. Burns., 28 (8): 752-9, 2002.

11- Andrew J. Lindford, Ilkka S. Kaartinen, Susanna Virolainen, Hannu O. Kuokkanen and Jyrki Vuola: The dermis graft: Another autologous option for acute burn wound coverage. Burns., 38: 274-282, 2011.

12- Draaijers L.J., Tempelman F.R., Botman Y.A., Tuinebreijer W.E., Middelkoop E., Kreis R.W., et al.: The patient and observer scar assessment scale: A reliable and feasible tool for scar evaluation. Plast. Reconstr. Surg., 113: 1960-1965, 2004.

13- Reed G.F., Zafra E., Ghyselen A.L., Goldstein J.C. and Robinett W.V.: Self-epithelialisation of dermal grafts. Arch. Otolaryngol., 87: 518-21, 1968.

14- Coruh A. and Yontar Y.: Application of split-thickness dermal grafts in deep partial- and full-thickness burns: A new source of auto-skin grafting. J. Burn Care Res., 33: e94- e100, 2012.

15- Fratila A.A. and Bertlich R.: The reversed dermal graft: surgical procedure and clinical applications. Facial Plast Surg., 13 (2): 93-9, 1997.

16- Querings K., Bachter D. and Balda B.R.: Meshed reversed dermal graft in patients with surgical defects of sole and scalp: Technique and long-term results. Dermatol. Surg., 28 (2): 122-6, 2002.

17- Kogan L. and Govrin-Yehudain J.: Vertical (two-layer) skin grafting: New reserves for autologic skin. Ann. Plast. Surg., 50 (5): 514-6, 2003.

18- Tanabe H.Y., Aoyagi A., Tai Y., Kiyokawa K. and Inoue Y.: Reconstruction for palmar skin defects of the digits and hand using plantar dermal grafting. Plast. Reconstr. Surg., 101: 992-8, 1998.